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Implementation of Decision Engineering Tool on International Destination Selection in Aviation: A Case of Nepal Airlines Corporation

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Abstract
AHP has been implemented for identification of the best destination for Nepal Airlines Corporation, for each destination there are multiple variables or criteria as profitability, passenger traffic, competition, operation and maintenance cost, resource management and marketing approach. The destination criteria are reviewed and selected by the questionnaires distributed to group of aviation experts. The expert opinion is the primary source of data on this research that is also validated with secondary data. AHP is implemented for generation of pairwise matrix of criteria with respect to criteria and alternative with respect to alternative. The Comparative result obtained from pairwise matrix gives the rank of the best destination between the currently operated destinations of Nepal Airlines Corporation. The research has identified Delhi is the top of the best destination based on all the criteria or variables. Delhi has best passenger traffic, marketing approach, profitability that shows Delhi should have more scheduled flights or Delhi destination has to set on higher priorities for destination planning. Delhi destination is followed by Kuala Lumpur and then by Doha, Bangkok and Hong Kong respectively. This destination priority can provide the planning framework for destination planning while implementation it can generate more market share and profit for Nepal Airlines Corporation. The result of AHP analysis is validated on this research; the real-time data of passenger traffic, revenue generated and competition scenario validate the final priority of destinations.

Keywords
Analytical Hierarchy Process – Multi Criteria Decision Analysis – Nepal Airlines – Destination Selection

1. Introduction

The Multi Criteria Decision Analysis (MCDA) and Analytical Hierarchy Process (AHP) are the decision engineering tools for decision support system for top-level management. Which enhance the chance of growth, profit and increased market share with less complication and risk factor. This research is introducing the well-adopted and reliable destination selection methodology in Nepal Airlines Corporation (NAC) destination planning. It is widely used methodology for the aviation industry; Brazilian Aviation Industry has used AHP for selection of Cargo Airlines[1] among the eight-cargo carrier available based on reliability, flexibility, speed of service and cost. African Aviation Industry use MCDA for choosing regional airport hubs in Africa. Turkish Airlines has implemented Analytic Network process with Multi Criteria Decision Making (MCDM) for selection of middle range and standard body Aircraft from different manufacturer. The Analytical Hierarchy Process is also used on research of selecting passenger airlines from Nepal to gulf countries with respect to four different major carrier, the research outcomes is helpful to passenger and ticketing personal to select the appropriate airlines in the respect of quality of food , service, cost, risk , airline profile comfort[2]. Similarly, AHP was used for analyzing the business competition on the Turkish domestic aviation industry[3].

Nepal Airlines is Nepal Flag Carrier Airlines and only one international Airlines until 2015. At best performing time and destination once, NAC flights to

European destination also but now all the Middle East based hub airlines are taking market share of the European passengers and Nepal airlines doesn't have flights there. Due to several reasons NAC has no more market share as in the 1990's. Now NAC major competitors are some Asian airlines such as budget airlines as Indian (spice jet, jet airways), Malaysian (Air AsiaX, Malaysian airlines), Middle East (Air Arabia, Qatar airlines, Etihad airways, Fly Dubai etc.), Thailand (Thai airways), Turkish airlines, Korean air, dragon airlines etc. These airlines are making good return from Kathmandu destination, while the NAC performance and market has shrink as much. In 90's NAC has high market share and market growth but now due to different factors NAC get decreased share and growth. Based upon the latest research and reviews some analysis can be pointed as:

Threats and Weakness of NAC: Old Boeing 757 Aircraft which are almost near to disassembly, no new marketing strategy adopted in past from market analysis and prediction, old manpower and less employee empowerment culture, political interference and less placement of top management, Asian legacy and budget airlines competition which adopt aggressive marketing and expansion strategy. NAC's market share in international flights to and from Nepal stands at 6.8 percent while its domestic market share is currently 1.33 percent, NAC also has a baggage of negative images including its punctuality and reliability, a lot of flights are cancelled and that its planes remain grounded. These will be seen as another major obstacle for growth. Penetration of past, past customer dissatisfaction, belief and quality of service.

Opportunities of NAC: Two New Airbus A320 aircraft has been purchased and deployed in 2015. NAC need to adopt a optimized resource utilization strategy and marketing strategy so that new aircraft can get maximum load factor and high market share with growth. NAC can increase those destination where the Nepalese are working so that they show more loyalty to own national carrier when NAC give best service and reliable. Nepal's only one international flag carrier, Government support achieved. Marketing is the most necessary for getting the high market share and precise planning is necessary for optimizing the resource management. German Flag carrier get interest on the NAC and proposals have been submitted by Lufthansa Consulting and German Aviation Capital to help it make a turnaround.

Strength of NAC: Most of the tangible resource are funded by government so less liability on loan, however in new aircraft cases liability is high. Human Resource is another strength of NAC because once they make NAC as good performing airlines with many international destination based services.

Challenges of NAC: It is indeed very difficult to recover from a negative image scenario in punctuality and reliability while this is improving in the current operations, adding that each staff at NAC should work hard and be dedicated to uplifting the corporation's image. Training and development is based on foreign countries like Europe, USA, and China for. No In house advance training facility for providing trainings and development regularly. Complicated Spare parts management, Inventory Management. Shortage of technical work force like pilots and engineers is also a big hindrance to NAC's growth. Most of the experienced pilots and engineers are either working for foreign companies or private airlines and it is a big challenge for NAC to attract them. Political interference has always managed to stunt the corporation's growth even as private airlines keep grabbing the opportunity presented by the ever-increasing capacity of Nepal is to spend and their adopting of air travel. NAC has forecast its revenue to jump to 504 million United States Dollar(USD) by 2024, of which it will be spending 447 million USD, thereby generating a profit of 57 million USD. To achieve this, NAC will be operating nine aircraft in the international sector, carrying 1.54 million passengers and increasing its market share to 27 percent. This growth forecast will not be easy to attain as there are many players in the market and in the first phase, we will have to create an image that NAC offers better facilities. However, it is not difficult to achieve this if more than 1300 staff associated with NAC play their roles effectively and are self-motivated to revive our lost glory. Airlines from India account for the largest share of inbound tourism in Nepal. According to Tribhuvan International Airport (TIA), Indian carriers flew almost 48 percent of all the tourists visiting Nepal in 2011.

The market share of Nepal Airlines Corporation (NAC) shrank to an all-time low in 2011 in terms of tourist carriage. The national flag carrier held the 10th position with a mere 3.05 percent. In 2010, NAC had a market

share of 4.87 percent. With more international airlines entering the Nepali skies and NAC's track record of flight delays, travel agencies said the national flag carrier had become the last choice among visitors. The carrier now flies to only five international sectors, Dubai, Doha, Bangkok, Kuala Lumpur and Hong Kong, down from around 14 in 2001. NAC has not added any new aircraft in the last two decades. "Without expanding the fleet, it is not possible to lead the market and expand flight connectivity".

Both capital and human resource is vital for enhancing the corporate capacity and competitive advantage of NAC. Unless NAC brings about a change in its corporate culture, it cannot initiate and implement capacity building and enhancement activities that will lead it to achieve growth and prosperity. Thus, the people sitting at the helm of decision-making must also take the initiative and show their commitment towards mending the corporate culture by developing and enhancing the professionalism of its staffs. NAC is now moving ahead in the process of capacity building by procuring required type and number of aircrafts for both international and domestic operation and also hiring people accordingly. It seems NAC has considered all necessary parameters in developing its strategic business and marketing plan. Otherwise it would not have made an ambitious revenue forecast for both international and domestic operations in the present context of the airline business environment. The actual results will start to come out after a few months after the aircrafts are put into operation Now, NAC is focusing on safety, reliability and providing cost-effective services to its passengers to regain lost ground. To assure the safety of passengers, NAC is working to adopt the best safety measures possible; to make it reliable, it is focusing on the timing of flights; and it will also be rolling out competitive and economic rates so that most of the Nepalese and other international passengers can rely on NAC.

A research on assessing satisfaction of international passenger using Nepal airlines is been done with the satisfaction parameter Inflight service, Reliability and Employee service. The overall passenger satisfaction was found to be neutral. This shows that the service provided by the Nepal Airlines is not satisfying as much to passenger like of other international fleet to Nepal.

2. Literature Review

The Analytic Hierarchy Process (AHP) is a structured technique for analyzing complex decisions[4][5]. The axiomatic foundation of the AHP carefully delimits the scope of the problem environment although it can be applied widely. AHP was developed by Thomas L. Saaty in the 1970s based on his mathematical and psychological knowledge and is also referred to as the Saaty method. The method is mathematically simple but the very practical tool. The AHP can transform one on- one comparison values into ratio-scale weighted values that are the combination between linear additives with the related alternatives. The core of AHP is building up a matrix expressing the relative values of the attribute set based on the pairwise comparison. There are the homogeneity axiom states that the elements being compared should not differ by too much in the property being compared.

On the top of AHP, there is AHP Expansion that is for determining the innovation performance criteria and providing the general guidelines to evaluate the relationship within criteria. It gives enough flexibility to apply for analyzing the innovation performance measure and guidelines how to handle the real situations. As for the advantages, the proposed method can be applied not only to quantitative measure but also to qualitative measure.

It is easy to use and can check the consistency of data able to remove the potential inconsistencies in advance. Because of using pairwise comparison, it has triggered to develop many other MCDM (Multiple Criteria Decision Making) methods and AHP (Expansion) is the mother of modern MCDM methods. As for the disadvantages, AHP (Expansion) could reverse the ranking of factors when the matrix contains identical values. In case of a simple MDCM case, all units of elements can be determined as the same units but many real-world MDCM situations may require multiple units for the different dimensions. However, AHP is one of most reliable and widely accepted MCDM methods. That is the reason why AHP is applied for measuring innovation performance as AHP Expansion framework .

Analytical Hierarchy Process has implemented on Brazilian aviation industry for air cargo transportation, they successfully implemented this system and provide benefits to cargo customer for cargo airlines selection [1].

According to the International Research the Cause of Japan Airlines bankruptcy are as follows: Expansion unnecessarily, Leadership, Personal Ego. So NAC has to learn from this lesion of Japan Airlines. MCDA implementation on multipath route selection, examples of Turkish airlines, Lufthansa and Air France.
In the AHP hierarchy goal setting is placed in the top which is to get the objective while there are multiple criteria as criteria 1 and criteria 2 and alternatives 1 alternative 2 and alternative 3 which is shown in figure 1 below. The criteria plays role for each alternative so according to the objective the best alternative has to be selected with the application of weightage the criteria for each alternative. So the best weightage value is placed on pairwise comparison matrix which gives the values or percentage of which alternative is best and which is least good.

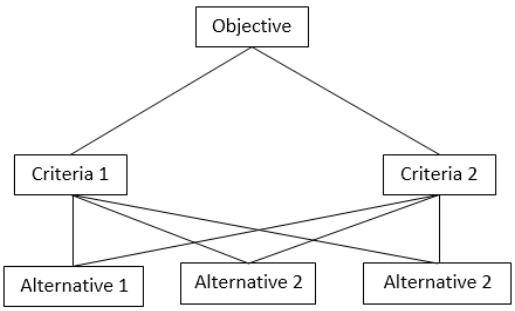

Figure 1: AHP Hierarchical decision structure[6]

3. Objective

1. To optimized destination priority out by the implementation of Multi-Criteria Decision Analysis /Analytical Hierarchy Process.
2. To suggest Nepal Airlines for strategy formulation and sustainable planning for specific international route to get more market share and competitiveness.

4. Methodology

The methodology involves stages that aid in the defining of the criteria, in the creation of the hierarchical decision structure, and in the assessment of the respective criteria and alternatives associated are being analyzed.The study is carried out in three distinct stages as shown in following.

Table 1 :Activities and Objectives

Activities	Objectives
Interviews with the specialist	To learn about the sector and variables
Assembly of decision making process model	To define the decision-making aspects and develop the decision model
Interview the main destination planner	To apply the model and generate analytics

The table 1 shows the activities of the research, this activity has specific objective to achieve. In the first activity the expert or specialist interview is been state which have make to understand the variables on international destination planning. In the first step the expert opinions is taken for generating the AHP pairwise matrix based on those variables. The decision-making and planning aspect of Nepal airlines has been studied in second stage, which gives the idea of decision-making process. After the AHP, implementation the analyzed outcomes will suggested for the real time destination planning at NAC. The Detail MCDA/AHP tools implementation methodology can be state as:

1. Data Collection and Identifying major international routes (flight present and other possible)
2. Identifying multi criteria, international specific competitors.
3. Identifying major variables and constraints on the basis of Delphi technique (Aviation Transportation Expert reviews)
4. Mapping the Resource, Resource planning, Resource and Market Forecasting based on different Operation and management science tools (Crystal Ball, Regression, Goal Programming, LP etc.)
5. Analyzing the data and identified resources
6. implementing AHP tools
7. Suggesting the best routes and Beneficiaries based on AHP and MCDA.

5. Results and Analysis

The AHP hierarchy has been designed on this research for getting the goals. The hierarchy is shown below in figure 2. This research has identified the variables on destination selection as profitability, passenger traffic, resource management, operation and maintenance and marketing approach. Those variables or criteria play major role on destination selection or planning. This criteria identification is done based on expert judgment and opinions. The alternatives or destinations of Nepal Airlines included in this research are Delhi, Kuala Lumpur, Hong Kong, Bangkok and Doha. From the AHP analysis the destination has been categorized as respect to the criteria or destinations variables.

The Major Criteria or Variable of the international destination selection are explained below.

Profitability (PF)
Profitability states for the possibility of profit generation on the destination. We can assume that some destination are more profitable than other destination.

Competition (CP)
Competition states for strength and scenario of competition on the destination. In some destinations the low cost carrier are expanding market share aggressively. So the competition measures the major criteria of the destinations.

Passenger Traffic (PT)
In aviation Passenger traffic is the passenger number or flow to specific destinations. The higher the number of passenger on destination higher the traffic occurred. This also signifies for number of Nepalese passenger and tourist passenger on the destination. Passenger traffic is formulated from the past data.

Operation and Maintenance Cost (OM)
The Operation cost is the minimal cost on flight on the destination. The cost may include flight cost, handling cost, airport cost and other necessary cost. Maintenance cost is the aircraft maintenance cost necessary after the flight on the destination.

Resource Management (RM)
Major Resource on aviation are Human resource and Aircraft. The number of aircraft and capable H.R shows the strength of the airlines to increase and sustain in the competitive market.

Marketing Approach (MA)
Marketing approach signifies for the international destination marketing on corresponding destinations or country. The number of marketing agents, marketing strategy determine the approach of marketing on destination.

5.1 Analysis

By the groups had been made up of different Aviation expert, each expert has been provided the weightage standard for alternatives and criteria of the destination selection. Group findings had shown the results from the pair wise comparisons matrices that were constructed based on the criteria selected. The data is presented in the following manner: (A) Pairwise Comparison Matrix and Computations: (Evaluation Criteria), (B) International Air route Pairwise Comparison Matrices and Priorities and (C) Computation of weights airlines alternatives.

Table 2 :Pairwise Comparison Matrix and Computations for the seven criteria

	PF	CP	PT	OM	RM	MA
PF	1	1.533	0.515	1.444	0.521	0.240
CP	0.652	1	0.857	1.589	0.857	0.720
PT	1.943	1.166	1	0.8024	1.271	1.595
OM	0.692	0.692	1.247	1	2.357	2.639
RM	1.920	1.116	0.787	0.424	1	2.089
MA	4.162	1.389	0.627	0.379	0.479	1
Column Total	10.370	6.884	5.033	5.638	6.485	8.283

Table 3 :Normalized Matrix of the seven criteria

	PF	CP	PT	OM	RM	MA	Weights
PF	0.096	0.223	0.102	0.256	0.080	0.029	0.131
CP	0.063	0.145	0.170	0.282	0.132	0.087	0.147
PT	0.187	0.169	0.199	0.142	0.196	0.193	0.181
OM	0.067	0.091	0.248	0.177	0.363	0.310	0.211
RM	0.185	0.169	0.156	0.075	0.154	0.252	0.165
MA	0.401	0.202	0.125	0.067	0.074	0.121	0.165
Column Total							1

Table 4 :Pairwise Comparison Weights with respect to Profitability (PF)

	DEH	KUL	DOH	BKK	HKG
DEH	1	4.333	3.917	4.222	2.482
KUL	0.231	1	3.500	4.417	2.292
DOH	0.255	0.2866	1	3.117	1.968
BKK	0.237	0.226	0.321	1	1.802
HKG	0.403	0.436	0.508	0.555	1
Weights	2.126	6.282	9.246	13.311	9.544

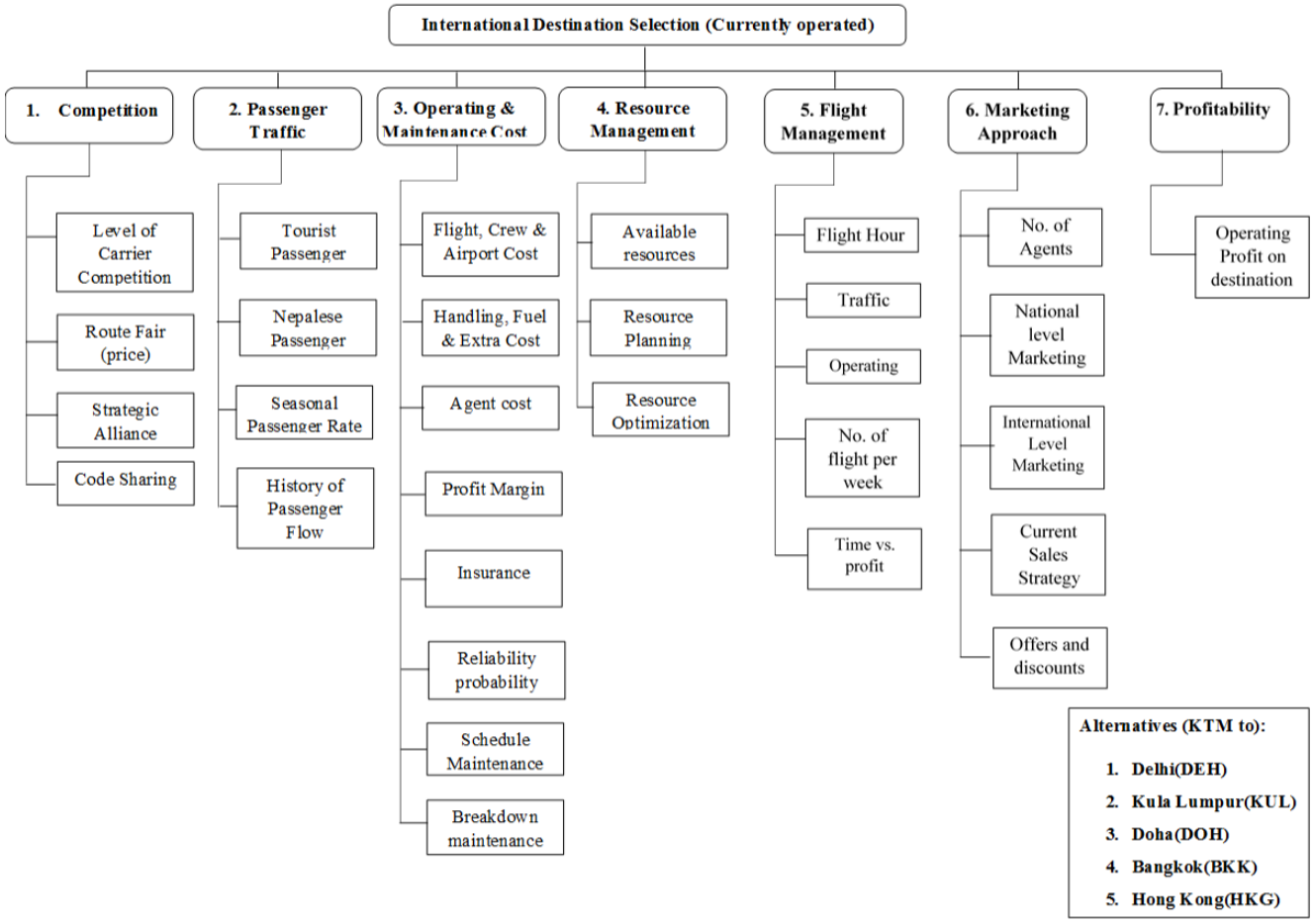

Figure 2: AHP hierarchy block diagram for international destinations selection

Table 5 :Pairwise Comparison Weights with respect to Competition (CP)

	DEH	KUL	DOH	BKK	HKG
DEH	1	1.500	2.333	3.000	2.389
KUL	0.667	1	2.667	3.083	1.972
DOH	0.429	0.375	1	1.172	1.944
BKK	0.333	0.324	0.853	1	1.389
HKG	0.419	0.507	0.514	0.720	1
Weights	2.847	3.706	7.367	8.976	8.694

Table 6 :Pairwise Comparison Weights with respect to Passenger Traffic (PT)

	DEH	KUL	DOH	BKK	HKG
DEH	1	1.446	2.089	3.278	1.983
KUL	0.692	1	2.417	3.083	1.667
DOH	0.479	0.414	1	2.292	1.111
BKK	0.305	0.324	0.436	1	0.589
HKG	0.504	0.600	0.900	1.698	1
Weights	2.980	3.784	6.842	11.351	6.350

Table 7 :Pairwise Comparison Weights with respect to Operation and Maintenance Cost (OM)

	DEH	KUL	DOH	BKK	HKG
DEH	1	2.819	2.806	2.464	2.742
KUL	0.355	1	1.867	2.583	1.583
DOH	0.356	0.536	1	1.778	1.583
BKK	0.406	0.387	0.563	1	1.639
HKG	0.365	0.632	0.632	0.610	1
Weights	2.482	5.374	6.866	8.435	8.547

Table 8 :Pairwise Comparison Weights with respect to Resource Management (RM)

	DEH	KUL	DOH	BKK	HKG
DEH	1	2.139	2.972	2.167	2.167
KUL	0.468	1	0.917	1.283	1.917
DOH	0.336	1.091	1	1.107	1.139
BKK	0.462	0.779	0.903	1	1.000
HKG	0.462	0.522	0.878	1.000	1
Weights	0.367	0.181	0.150	0.153	0.138

Table 9 :Pairwise Comparison Weights with respect to Marketing Approach (M.A)

	DEH	KUL	DOH	BKK	HKG
DEH	1	4.000	3.222	3.667	3.139
KUL	0.250	1	1.583	1.833	1.542
DOH	0.310	0.632	1	1.742	1.083
BKK	0.273	0.545	0.574	1	1.167
HKG	0.319	0.649	0.923	0.857	1
Weights	0.465	0.147	0.137	0.110	0.126

The above pairwise comparisons in table 4-9,it shows that the comparison of destination with respect to the criteria of destination selection as Profitability (PF) , Competition (CP), Passenger Traffic (PT), Operation and Maintenance Cost (OM), Resource Management (RM), Marketing Approach (MA). The three steps (sum of the elements in each column, divide each value of matrix by its column sum and find out the priority vector by computing row averages) is used to determine the weights of the International Route for each criterion.

Table 10 :Computation of weights of International Destination/Alternatives

	PF	CP	PT	OM	RM	MA	Weights
	0.131	0.147	0.181	0.211	0.165	0.165	
DEH	0.432	0.336	0.325	0.390	0.366	0.458	0.383
KUL	0.244	0.287	0.277	0.218	0.190	0.175	0.231
DOH	0.143	0.148	0.159	0.157	0.159	0.140	0.152
BKK	0.089	0.118	0.087	0.126	0.147	0.108	0.113
HKG	0.092	0.110	0.153	0.109	0.137	0.118	0.121
Total							1

The Table 10 shows the computation of the weights of the alternatives. From table 10 alternative DEH (Delhi) is best alternative destination than other four other. Secondly, KUL (Kuala Lumpur) is the second best destination with respect to all criteria and DOH (Doha) is third best alternative, HKG (Hong Kong) is fourth best alternative destination and BKK (Bangkok) is the fifth best destination.

6. Conclusion

The average passenger flown in KUL destination between July 2014 and April 2015 is 12893 which is decreasing rapidly in the later months. Delhi destination is re-started on February 2015 in which the number of passenger is increasing rapidly which is shown in figure 4.The revenue generation is shown in figure 3 below. While the passenger flow in Doha is average of 8726 which is also decreasing. The final pairwise matrix result is validated by the above data in the sense of passenger traffic. Passenger flown follows the revenue in the destination. According to the aviation expert the revenue can be related with profit generation so the Delhi destination is more profitable destination cause of less direct expenses and maintenance cost and which is followed by KUL and DOH.

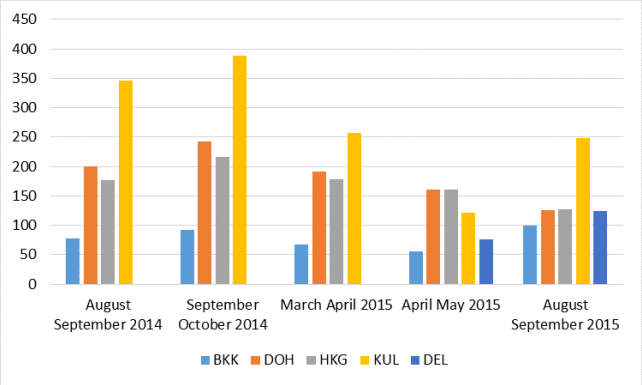

Figure 3: Revenue generation on destinations(in Million Rupees)

This research suggest the Aircraft Airbus A320 which is in the current fleet of operation in Nepal airlines, the two A320 (9N-AKW and 9N-AKX) is now in operation. While according to NAC two Boeing 757-200 are going to phase out very soon because of their large period of operation, maintenance cost, fuel consumption and other overhead costs.

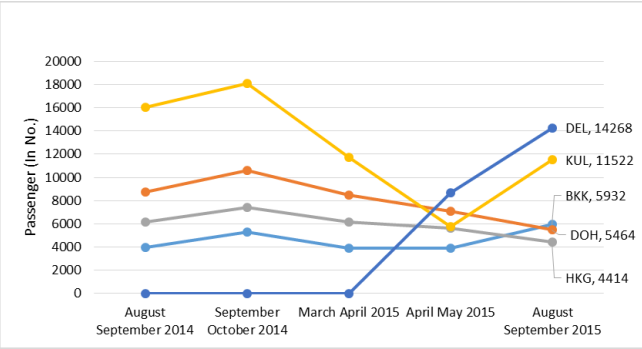

Figure 4: Passenger traffic at different destinations

This research has identified the variables on destination selection as profitability, passenger traffic, resource management, operation and maintenance and marketing approach. Those variables or criteria play major role on

destination selection or planning. This criteria identification is done based on expert judgment and opinions. The alternatives or destinations of Nepal Airlines included in this research are Delhi, Kuala lumpur, Hong Kong, Bangkok and Doha. Form the AHP analysis the destination has been categorized as respect to the criteria or destination variables.

Recommendations

Based on the findings of the research, the recommendations for the destination selection and planning are depicted as follows.

1. Delhi is the best and profitable destination on the basis of variables presented on the research.
2. This research finding can be incorporated on the destination selection and planning for Nepal Airlines.

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